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Transmitted herewith for filing is the patent application of:

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Title: **SUBSCRIPTION MANAGEMENT SYSTEM FOR DATA COMMUNICATION NETWORK**

Enclosed are:

[X] 23 pages of specification, 7 pages of claims, abstract and a Combined Declaration and Power of Attorney;
[X] 9 sheets of [X] formal [ ] informal drawings;
[ ] Assignment with assignment recordation cover sheet;
[ ] Verified statement(s) to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27 by [ ] Independent Inventor; [ ] Small Business Concern)
[ ] Information Disclosure Statement;
[ ] Form PTO-1449 and copies of documents listed thereon.

<u>CLAIMS AS FILED</u>

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Respectfully,

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SUBSCRIPTION MANAGEMENT SYSTEM
FOR DATA COMMUNICATION NETWORK

Technical Field

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This invention relates to the management of data communication networks. In particular the invention relates to systems and methods for facilitating the creation and maintenance of connections between subscribers and services

10   provided by way of a data communication network.

Background

There is a need for systems which can be used to

15   provide services to users connected to data communication networks. Services may include things such as video-on-demand, audio-on-demand, on-line games and amusements, or Internet access, which are provided by a service provider, to subscribers who are connected to a data communications network.

20

The currently accepted approach to setting up the network connections needed to provide such services is tedious, requires technically skilled personnel and is susceptible to errors. First, the physical port to which the subscriber is

25   attached to the network must be identified. Next, the service's connection requirements, including bandwidth, must be studied to determine what sort of connection is needed. Appropriate connections from one or more of the service provider's servers to

the subscriber's physical port can then be established. The connections must be monitored for billing purposes and billing information must be accumulated and associated with the subscriber.

5

Existing network management tools such as the MainStreetXpress™ 46020™ network manager available from Newbridge Networks Corporation of Kanata, Ontario, Canada provide for the centralized management of network connections

10 but operate at a low level. Such management tools allow an operator to configure network nodes, cards and modules and manage links and paths throughout a network from a single location. The operator must still, however, have reasonably advanced technical knowledge of the network and must

15 manipulate physical port addresses and other similarly low level information to set up a service for a subscriber.

Another problem with existing network management tools is that they track network statistics in a manner which

20 provides the information necessary to make "wholesale" sales of network bandwidth but do not provide sufficient information to conveniently bill on a selective basis for particular services provided over the network. The inability of existing network management systems to collect the information necessary to bill

25 for individual services has provided an obstacle to the deployment of such services by network providers.

Summary of the Invention

This invention provides a management system for a data communication network. The management system allows for the creation of subscriptions which each relate a subscriber to a service. The management system can create communication channels needed to provide the subscription to the subscriber automatically. It is not necessary for a human operator of the management system to provide low level information about the network each time a subscription is created.

In one aspect of the invention, the management system comprises a plurality of application objects each corresponding to an application available on a data communication network and each specifying a network connection point for the corresponding application. The application objects may be stored in a database accessible to the system. The system also comprises a plurality of subscriber objects each corresponding to a subscriber having a connection to the data communication network, each subscriber object specifying a network connection point for the corresponding subscriber. The subscriber objects may also be stored in the database. The system has a user interface which permits a user to create a subscription object associating one of the subscriber objects and one of the application objects. The system includes a network manager which creates in the data communication

network a communication channel for each subscription object.
The communication channel connects the network connection
point for the subscriber of the subscription object and the
network connection point for the application of the subscription

5   object. In the case of an ATM network the communication
channel is a virtual channel connection ("VCC"). In the case of a
frame relay network the communication channel may be a
frame relay path ("FRP").

10   The operator who creates the subscription object
does not need to deal with low level information such as physical
port numbers. Thus the invention ameliorates some of the
disadvantages of prior art systems which are identified above.
The capacity and other quality of service parameters for the

15   virtual channel connection are preferably included in the
application object for each application so that the system
automatically creates an appropriate communication channel
for each subscription.

20   Preferred embodiments of the system track statistics
for each communication channel used in the delivery of a
subscribed service to a subscriber. The statistics are associated
with subscriptions. The statistics may be used to bill the
subscriber for the service even if several different

25   communication channels are used to provide the service. The
management system preferably includes a statistics collector.

The statistics collector collects statistics regarding those communication channels of the data communication network which correspond to each subscription. The management system comprises means for selecting and aggregating statistics for all

5 of one or more communication channels used in the provision of a service according to a subscription over a selected period.

The invention also provides a method for managing the provision of services to users of a data communications

10 network. The method comprising, in a computer system: storing in a database accessible to the computer system subscriber information identifying a plurality of subscribers and application information identifying one or more applications available to the subscriber; receiving user input identifying one

15 subscriber and one application to be associated as a subscription; retrieving from the database a subscriber network connection point from the subscriber information for the one subscriber and an application network connection point from the application information for the one application; and, creating a

20 virtual channel connection in the data communications network extending between the subscriber network connection point and the application network connection point. The virtual channel connection is created automatically between the correct endpoints without the requirement for an operator to manually

25 specify points of network connection for the user or the application. The method of the invention accordingly provides a

simplified procedure for providing services to subscribers on a data communications network. The following specification and claims point out other aspects and benefits of the invention.

5   Brief Description of Drawings

In drawings which illustrate non-limiting embodiments of the invention,

Figure 1 is a schematic view of a data communication network comprising a service subscription manager according to

10   the invention;

Figure 1A is a schematic view of a service subscription manager according to the invention being used in the management of subscriptions on a two part data communication network;

15   Figure 2 is a schematic representation of a service subscription manager according to the invention;

Figure 3 is a representation of the relationships between some of the main objects in object oriented software embodying the invention;

20   Figure 4 is a schematic view illustrating the connection of a service selection agent to the a network equipped with a subscriber management system;

Figure 5 is a depiction of a graphical user interface of a type which may be presented to a subscriber by a service

25   selection agent according to the invention;

Figure 6 is a schematic view of a system for client-side load balancing according to the invention; and,

Figure 7 is a flow chart illustrating a method according to the invention.

5

Description

Figure 1 is a schematic view of a network **20**. For the purpose of illustration, network **20** is an ATM network. Network **20** could be any other suitable type of network in which

10   communication channels can be set up between different points on the network.

Network **20** comprises a number of Asynchronous Transfer Mode ("ATM") switches **24** connected by

15   communication lines **26**, each capable of carrying digital information. One or more service providers provide servers **28** connected to network **20** by way of suitable access devices **30**. A number of users or "subscribers" **32** are also connected to network **20** by way of suitable access devices **30**. Access devices

20   **30** for users **32** may be, for example, Digital Subscriber Line ("DSL") modems or wireless access devices.

Servers **28** can provide one or more services or "applications" to users **32**. For example, a service might be the

25   delivery of an audiovisual work (such as a movie) from server **28** to a particular user **32A** through network **20**. User **32A** may be

termed a subscriber who subscribes to the service provided from server **28**. To enable such a service to be provided it is necessary to configure network **20** to provide a virtual channel connection ("VCC") (indicated by dashed line **40**) from server **28** to the

5   access device **30A** for subscriber **32A**. In many typical embodiments of the invention, VCC **40** is a Permanent Virtual Connection ("PVC").

VCC **40** must have sufficient bandwidth to provide

10   the desired service. Where the service is delivery of an audiovisual work, VCC **40** must have sufficient bandwidth to carry the audiovisual work to subscriber **32A**. If a service other than the delivery of an audiovisual work is provided then one or more VCCs each having an appropriate bandwidth and

15   providing an appropriate level of Quality of Service ("QoS") will need to be set up so that the service can be delivered to subscriber **32A**.

VCC **40** is created by configuring switches **24**. A

20   network manager 44, such as the MainStreetXpress™ 46020™ network manager, is attached to network **20**. An operator of network manager 44 could configure switches **24** to provide VCC **40**. To do this the operator would need to know in advance, or find out, the physical port at which access device **30A** is

25   connected to network **20** as well as the bandwidth and other QoS requirements for VCC **40**. The operator can enter this

information into network manager **44**. Network manager **44** then sends commands to switches **24** to cause VCC **40** to be set up and connected. Looking up and manually entering such information can be tedious and can result in errors which either

5   impair the service or prevent the service from operating at all. The errors may be hard to locate.

This invention provides a network management system **45** which includes a service subscription manager **46**

10   which communicates with one or more network managers **44** through one or more communication links **47**. Communication link **47** may be provided by network **20**. Service subscription manager **46** contains one or more databases **50** which associates each subscriber **32** as identified by easily ascertainable

15   information, such as name, address, telephone number or the like, with physical information needed to establish a VCC to that subscriber including port number on network **20**.

In the preferred embodiment of the invention, service

20   subscription manager **46** comprises two databases **50** and **51**. This provides flexibility in implementation. Database **50** contains service level information and database **51** contains technical information regarding the resources of network **20**. Database **50** may contain, for example, the following

25   information about each subscriber **32**: account name; password; contact information such as telephone number, e-mail address,

postal address; personal information; administrative status; a list of services to which the subscriber has subscribed; and an association with technical network access information which is stored in database **51**. Databases **50** and **51** are preferably

5   implemented using object oriented database software.

    Database **50** also associates services or "applications" provided by service providers, once again identified by easily ascertainable information such as a trade-mark, logo, provider

10   name, or the like, with information describing the one or more VCCs needed to provide the service to any one of subscribers **32**. Database **50** may contain, for example, the following information for each application: application provider; name; logo; e-mail contact for trouble reports; e-mail contact for service

15   enquiries; a set of subscribers to the application; and associations to technical information about the class of service used to provide the application, and network access (application delivery point(s)) which are stored in database **51**.

20   A third database (not shown) is preferably provided to track the rights that various operators of service subscription manager **46** have. For example, some operators may have rights to modify existing subscriptions but not to create new subscriptions, and so on.

25

An operator of system **45** can cause the VCCs
necessary to provide a service to a subscriber **32A** to be set up
by creating a subscription in service subscription manager **46**. A
subscription associates a subscriber **32A** with a service, for

5   example a service provided from server **28**. Particulars of the
subscription are then stored in databases **50** and **51**.

As shown in Figure 2, service subscription manager
46 preferably comprises software **54** running on a suitable

10   network-connected computer **56**. Software **54** has access to read
and write to databases **50**, **51** and an interface **55** to network
manager **44**. Service subscription manager **46** also has a user
interface, which is preferably but is not necessarily a graphical
user interface ("GUI") **58**. The interface, for example GUI **58**,

15   may be provided on computer **56** or on a separate computer
connected to computer **56**. When an operator creates a new
subscription (which associates a service and a subscriber),
software **54** generates one or more messages which are sent to
network manager **44** via interface **55**. The messages cause

20   network manager **44** to set up the VCC(s) required by the new
service. The messages include information from databases **50**
and **51** specifying the attributes of the VCC(s) required by the
new service.

25   It is convenient to describe software **54** using object
oriented software engineering terminology. Object oriented

software comprises a number of interacting software objects. Each object represents a real or abstract entity. Each object includes data which is encapsulated in the object and software which can manipulate the data and control how the object

5   interacts with other objects. Figure 3 illustrates relationships between objects of an embodiment of software **54** in Universal Modelling Language ("UML").

Using such an object oriented description permits a

10 subscriber **32** to be represented in software **54** as a subscriber object **33**. Each subscriber object **33** contains or is linked to data which includes the name of the subscriber and the physical port through which the subscriber accesses network **20** (subscriber network access object **57**). A service, such as the service

15 provided by server **28** may be represented as a service object **29**. The service object **29** contains, or is linked to, data which includes the name of the service, the level of QoS required by the service (class of service object **59**), and the physical port (or ports) through which server **28** accesses network **20** (application

20 network access object **61**).

A subscription object **60** links a service object **29** and a subscriber object **33**. The subscription object may contain or link to data, such as statistics on the use of the service which

25 may be used for billing purposes.

The subscription VCC object **62** links subscription object **60** to VCC object **67** which represents the actual VCC **40** which will be used by the subscription. VCC object **67** defines a virtual connection between endpoints specified by VCC

5 endpoints object **69**. The VCC endpoints are determined by the network port object **71** associated with the network access **64** which is associated with each of the application network access **61** and the subscriber network access **57**. The application and subscriber network access objects each inherit the attributes of

10 network access object **64**.

A subscription object **60**, together with the service object **29** and the subscriber object **33** which it associates, contain all of the information necessary to set up VCC **40**

15 including the port at which subscriber **32A** connects to network **20** (from the subscriber network access object **57**), the port at which server **28** connects to network **20** (from the application network access object **61**), and the bandwidth and any other QoS requirements on VCC **40** (from the class of service object **59**).

20 Preferably, various classes of service are predefined. Each class of service specifies QoS parameters such as: service category, peak information rate in each direction, and sustained information rate in each direction. Each application can have its own asymmetrical class of service definition. The various objects

25 used by software **54** may be stored in databases **50** and **51**.

Service subscription manager **46** generates commands which cause network manager **44** to create VCCs **40**. The commands include the information needed by network manager **44** to set up VCCs **40**. Network manager **44**

5   subsequently causes switches **24** to configure themselves to provide VCCs **40**.

In some cases network manager **44** will not have control over all of network **20**. Figure 1A shows a situation

10   where a network has two portions **20A** and **20B** connected at a point of presence **POP**. Network manager **44** only has direct control over portion **20A** of the network. A separate network manager **44A** which is not under the direct control of service subscription manager **46** manages portion **20B** of the network.

15   This situation might exist, for example, where different infrastructure providers maintain portions **20A** and **20B**. If a service provider **SP1** and a subscriber **32** are both in portion **20A** of the network then network manager **44** can create the necessary communication channel **40C** directly. On the other

20   hand, if the service provider is in a different portion of the network from subscriber **32** then communication channels must be set up in both of portions **20A** and **20B**. Service subscription manager **46** directly commands network manager **44** to create a communication channel **40B** between subscriber **32** and point of

25   presence **POP**. Service subscription manager **46** also generates a work order message **49** asking that a communication channel

40C from point of presence **POP** to service provider **SP2** be created. The work order messages may be sent by calling a remote script from software **54**.

5   Service subscription manager **46** preferably includes a facility to enable or disable subscriptions that are set up in service subscription manager **46** without deleting the subscriptions. This facility might be used, for example, to temporarily suspend a subscription for which a subscriber's

10   payment is overdue. This facility may be provided by including an "enable" attribute in the subscription object **60**. The enable attribute can be set to one state to enable the subscription in question and set to another state to disable the subscription in question. When an operator commands software **54** to disable a

15   service, software **54** sets the "enable" attribute for the subscription in question to its disabled state and sends a command to network controller **44** instructing network controller **44** to take down the VCCs for the service in question. Preferably, service subscription manager **46** also permits

20   subscribers to turn on or off subscriptions that have been previously set up.

In order to conserve network resources, VCCs **40** are preferably connected only when a service is in use. For example,

25   service subscription manager **46** may cause network manager **44** to connect the VCCs **40** for a particular service when a

subscriber **32** who has a valid subscription logs onto network **20** and is assigned a network access and enables the subscription, or when a subscription is added for a subscriber who already has a network access or when a disabled subscription for a

5 subscriber who already has a network access is enabled. The VCCs may be taken down when a subscriber **32** who has a valid and enabled subscription logs out from network **20** (and thereby removes their network access) or when an enabled subscription is cancelled or becomes disabled.

10

Preferably, service subscription manager causes the VCCs for a subscription to be enabled only when the following conditions all hold:

1. the subscriber is "enabled" (a subscriber might not be
15 enabled if the subscriber were a new subscriber, not yet completely entered into the system or if the subscriber had not paid its bills);

2. the subscription is enabled;

3. the application (service) is enabled;

20 4. the subscriber's network access is enabled and operational;

5. the service provider's network access is enabled and operational; and,

6. the subscriber has not turned the subscription off.

25 Network manager **44** includes a statistics collector, as is known in the art. The statistics collector may, for example,

be the statistics collector function of a Newbridge™ 46020 network manager. The statistics collector collects statistics regarding the usage of each VCC provided on network **20** including the volume of data transferred over the VCC and the

5   length of time that each VCC is connected. The raw information provided by the statistics collector is not directly useful for billing for services because several different VCCs may be used to provide the same service over time.

10   Service subscription manager **46** periodically receives statistics from network manager **44** and collects together the statistics that relate to VCCs used by each subscription. Service subscription manager **46** does this by identifying the VCCs used by each subscription from the

15   information in databases **50** and **51** and by searching the statistics provided by network manager **44** for statistics on those VCCs. Service subscription manager **46** then produces concise records which summarize the aggregate usage of network resources by each subscription over a selected period.

20   The records may be used by a billing system to bill subscribers **32** for usage of network **20**.

Preferably network **20** is partitioned so that the network access points for subscribers **32** and the application

25   network access points for server(s) **28** and all of the PVCs

between them are placed into one or more Virtual Switched Networks ("VSNs").

It is useful to provide subscribers **32** with a

5   mechanism to select and control their subscriptions. As shown in Fig. 4, The invention provides a Service Selection Agent ("SSA") **70** which interfaces with service subscription manager **46** by way of a suitable Application Programming Interface ("API") **72**. API **72** is preferably a CORBA based API. SSA **70**

10   may be maintained and operated by a carrier who may be a different entity than the entity which provides and operates network **20**, network manager **44** and service subscription manager **46**.

15   Subscribers **32** can communicate with SSA **70** by way of a web based interface indicated by line **74**. Subscribers can use SSA **70** to dynamically switch between different services. For example, a subscriber **32** who had subscriptions to both a work-at-home session and a general high-speed Internet

20   access service could use SSA **70** to dynamically switch between these two services. When a subscriber uses SSA **70** to enable a service, service subscription manager **46** commands network manager **44** to connect the VCC **40** required by that service. SSA **70** preferably also permits subscribers to sign up for new

25   subscriptions for themselves.

SSA **70** obtains information about the services subscribed to by each subscriber through API **72**. Links to each service may be displayed on the web page of SSA **70**. Figure 5 shows an example web page which could be provided by a

5   suitable server **71** associated with SSA **70** to enable a subscriber **32** to *inter alia* select between subscribed services, enable or disable subscribed services, or to obtain information about the status of the subscriber's subscriptions. The web page of Figure 5 would be made available to a subscriber only after the

10   subscriber had entered an account name and a password.

SSA **70** will typically have a plurality of servers **71** so that many subscribers can be serviced at the same time. SSA **70** could, for example, comprise an application running on a

15   Netscape™ Enterprise Server. Servers **71** may invoke commands on service subscription manager **46** by way of API **72** to authenticate the identity of a subscriber **32** before allowing the subscriber **32** access to information about subscriptions via SSA **70**. Servers **71** may obtain information about subscriptions

20   of a subscriber **32** by causing service subscription manager **46** to interrogate database **50** and forward the requested information via API **72**.

One problem that can occur is that one or more of

25   servers **71** may be over utilized. Subscribers connected to the over utilized servers **71** will experience slow response times. At

the same time, other ones of servers **71** may be idle or only lightly utilized. Preferred embodiments of the invention provide client-side load balancing to more evenly distribute subscribers among servers **71**. Figure 6 illustrates apparatus for providing

5   client-side load balancing in the invention. Figure 6A illustrates a method **90** of client-side load balancing according to the invention.

As shown in Figure 6, a user runs user software **80**

10   to connect to one of service selection servers **71** of SSA **70**. User software **80** may be, for example, a JAVA applet running on a subscriber's network connected computer. Software **80** interrogates a name server **82** which returns an address for one of service selection servers **71** as indicated by line **84** (step **91**).

15   Software **80** then connects to the assigned service selection server **71** as indicated by line **85** (step **92**). Name server **82** is designed to assign service selection servers **71** to subscribers in such a fashion that a roughly equal number of subscribers are serviced by each service selection server **71**. Suitable hardware

20   and software for implementing name server **82** is known to those skilled in the art and is available off the shelf from various parties and will therefore not be described herein.

The foregoing scheme does not take into account the

25   fact that some subscribers may place much higher demands on a service selection server **71** than other subscribers. The invention

provides a timer **86** in user software **80**. A user uses GUI **58A** to

enter commands for processing at service selection server **71**,

the commands are forwarded to service selection server **71** by

the user's computer under the control of software **80** (step **93**).

5   Timer **86** monitors the time taken by the service selection server

71, to which the software **80** is connected, to respond to certain

commands (step **94**). If the response time becomes excessive (i.e.

the response time exceeds a threshold time) then user software

80 sends a request to name server **82** that it be connected to a

10   different service selection server **71** (step **95**). Currently

available name servers **82** support requests from client software

to be connected to a different server. The threshold time may be

a preset value which is provided in user software **80** or may be a

value which is computed from previous response times

15   experienced by software **80**. Name server **82** returns the address

of a different service selection server **71** for the user software **80**

to connect to (step **96**). Name server **82** may select the different

service selection server **71** randomly from other available

service selection servers **71**. User software **80** then connects to

20   the new service selection server **71** (step **97**). The result is that

the loads on service selection servers **71** tend to become

balanced because user software **80** which is experiencing

unacceptable response times from a service selection server **71**

will switch to a different service selection server **71**.

25

While the invention has been described above with
reference to a network subscription management system, the
invention also provides a method **100** for managing the
provision of services to users of a data communications network.

5   The method is performed in a computer system. As shown in
Figure 7, the method begins with storing in database **50**
accessible to computer system **56** subscriber information
identifying a plurality of subscribers and application
information identifying one or more applications available to the

10   subscriber (indicated by **110**). The method continues with
receiving user input identifying one subscriber and one
application to be associated as a subscription (indicated by **112**).
When the subscription has been made, the method retrieves
from database **50** a subscriber network connection point from

15   the subscriber information for the one subscriber and an
application network connection point from the application
information for the one application (indicated by **114**).The
method finishes by automatically creating a virtual channel
connection (VCC **40**) in the data communications network **20**.

20   The VCC extends between the subscriber network connection
point and the application network connection point.

As will be apparent to those skilled in the art in the
light of the foregoing disclosure, many alterations and

25   modifications are possible in the practice of this invention
without departing from the spirit or scope thereof. For example,

the invention may be used in non-ATM networks. Various specific types of hardware and software may be used in the implementation of the invention. The method for balancing loads on service selection servers **71**, which is described above,

5   may be used to balance loads on other kind of web servers. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

WHAT IS CLAIMED IS:

1. A management system for a data communication network, the management system comprising:

5   a)   a plurality of application objects each corresponding to an application available on a data communication network and each specifying a network connection point for the corresponding application;

     b)   a plurality of subscriber objects each corresponding

10   to a subscriber having a connection to the data communication network, each subscriber object specifying a network connection point for the corresponding subscriber;

     c)   a user interface permitting an operator to create a

15   subscription object associating one of the subscriber objects and one of the application objects; and,

     d)   a network manager for creating in the data communication network at least one communication channel for each subscription object, the

20   communication channel connecting the network connection point for the subscriber of the subscription object and the network connection point for the application of the subscription object.

25 2. The management system of claim 1 wherein the application objects each contain information specifying a

quality of service level for the communication channel and the network manager is adapted to create the communication channel having the specified quality of service level.

5

3. The management system of claim 2 wherein the quality of service level includes a peak bit rate for communications over the communication channel in a direction from the subscriber to the application and a different peak bit rate

10 for communications over the communication channel in a direction from the application to the subscriber.

4. The management system of claim 1 wherein each subscription has a status, the system includes means for

15 an operator to set the status to enabled or disabled and the network manager is adapted to cause the data communication network to disconnect the communication channel for a subscription whenever the status of the subscription is disabled.

20

5. The management system of claim 4 comprising a service subscription agent, the service subscription agent comprising a user interface accessible to a subscriber, the user interface providing a control whereby the subscriber

25 may change the status of any of one or more subscriptions

of that subscriber from enabled to disabled or from disabled to enabled.

6. The management system of claim 1 comprising a statistics collector, the statistics collector collecting statistics regarding communication channels of the data communications network, the management system comprising means for selecting and aggregating statistics for all of one or more communications channels used in the provision of a service of a subscription over a selected period.

7. The management system of claim 1 wherein the data communications network comprises an ATM network and the communication channels are virtual channel connections.

8. The management system of claim 1 wherein no virtual channel connection is associated more than one subscription.

9. The management system of claim 5 wherein the network comprises a name server and the service selection agent comprises a plurality of service selection servers and a plurality of user software capable of connecting to the service selection servers, wherein the user software

comprises a timer connected to measure a response time taken for a connected service selection server to respond to a command and the user software is adapted to request from the name server a connection to a different service

5   selection server if the measured response time exceeds a threshold time.

10.   A method for managing the provision of services to users of a data communications network, the method comprising,

10   in a computer system:

a)   storing in a database accessible to the computer system subscriber information identifying a plurality of subscribers and application information identifying one or more applications available to the

15   subscriber;

b)   receiving user input identifying one subscriber and one application to be associated as a subscription;

c)   retrieving from the database a subscriber network connection point from the subscriber information for

20   the one subscriber and an application network connection point from the application information for the one application; and,

d)   creating a communications channel in the data communications network extending between the

25   subscriber network connection point and the application network connection point.

11.   The method of claim 10 wherein the data communications network comprises an ATM network and the communications channel comprises a virtual circuit connection.

5

12.   The method of claim 11 wherein the application information comprises information specifying a quality of service level for the virtual circuit connection and creating the communication channel comprises creating a virtual

10   circuit connection having the specified quality of service level.

13.   The method of claim 12 wherein the quality of service level includes a peak bit rate for communications over the

15   communication channel in a direction from the subscriber to the application and a different peak bit rate for communications over the communication channel in a direction from the application to the subscriber.

20 14.   The method of claim 11 comprising disconnecting the communication channel for a subscription whenever:

(a)   the corresponding subscriber is not enabled;

(b)   the subscription is not enabled;

(c)   the corresponding application is not enabled;

25   (d)   a network access for the subscriber is not enabled and operational; or

(e)   a network access for the application provider is not enabled.

15.   The method of claim 10 comprising providing a service selection agent comprising a user interface accessible to a subscriber, the user interface providing a control whereby the subscriber may change the status of one or more subscriptions of that subscriber from enabled to disabled or from disabled to enabled.

16.   The method of claim 15 wherein the service selection agent comprises a plurality of service selection servers and the method includes connecting user software to a service selection server; measuring a response time of the service selection server; and, connecting the user software to a different one of the service selection servers if the measured response time exceeds a threshold time.

17.   The method of claim 10 comprising collecting statistics regarding communication channels of the data communications network and periodically selecting and aggregating statistics for all of one or more communications channels associated with each subscription.

18.   The method of claim 17 wherein the data communications
        network comprises an ATM network and the
        communication channels are virtual channel connections.

5   19.   A method for balancing loads between a plurality of web
        servers, the method comprising:

        a)   providing a plurality of web servers, a name server,
                and a plurality of clients;

        b)   connecting each of the clients to one of the web
10   servers;

        c)   at each client, measuring a response time of the
                connected web server; and,

        d)   requesting from the name server a connection to a
                different one of the web servers if the response time
15   exceeds a threshold time.

Abstract of the Disclosure

A network management system allows operators to set up subscriptions to services for network users. The subscriptions each associate a subscriber object and an application object. The subscriber object contains information about the subscriber's network connection. The application object contains information about the application's network connection. The operator does not need to work with low level information such as physical port numbers to create a subscription. The system automatically sets up one or more virtual channel connections as needed to provide the application to the subscriber. The system can be easier to operate accurately than current systems. The system may track and accumulate statistics on a service-by-service basis. The statistics may be used to bill for individual services even if several different virtual channel connections are used to provide each service.

FIG 1

FIG 1A

56

54

SOFTWARE

58

GUI

INTERFACE TO
NETWORK
MANAGER

55

DATABASE

50

DATABASE

51

NETWORK
MANAGER

44
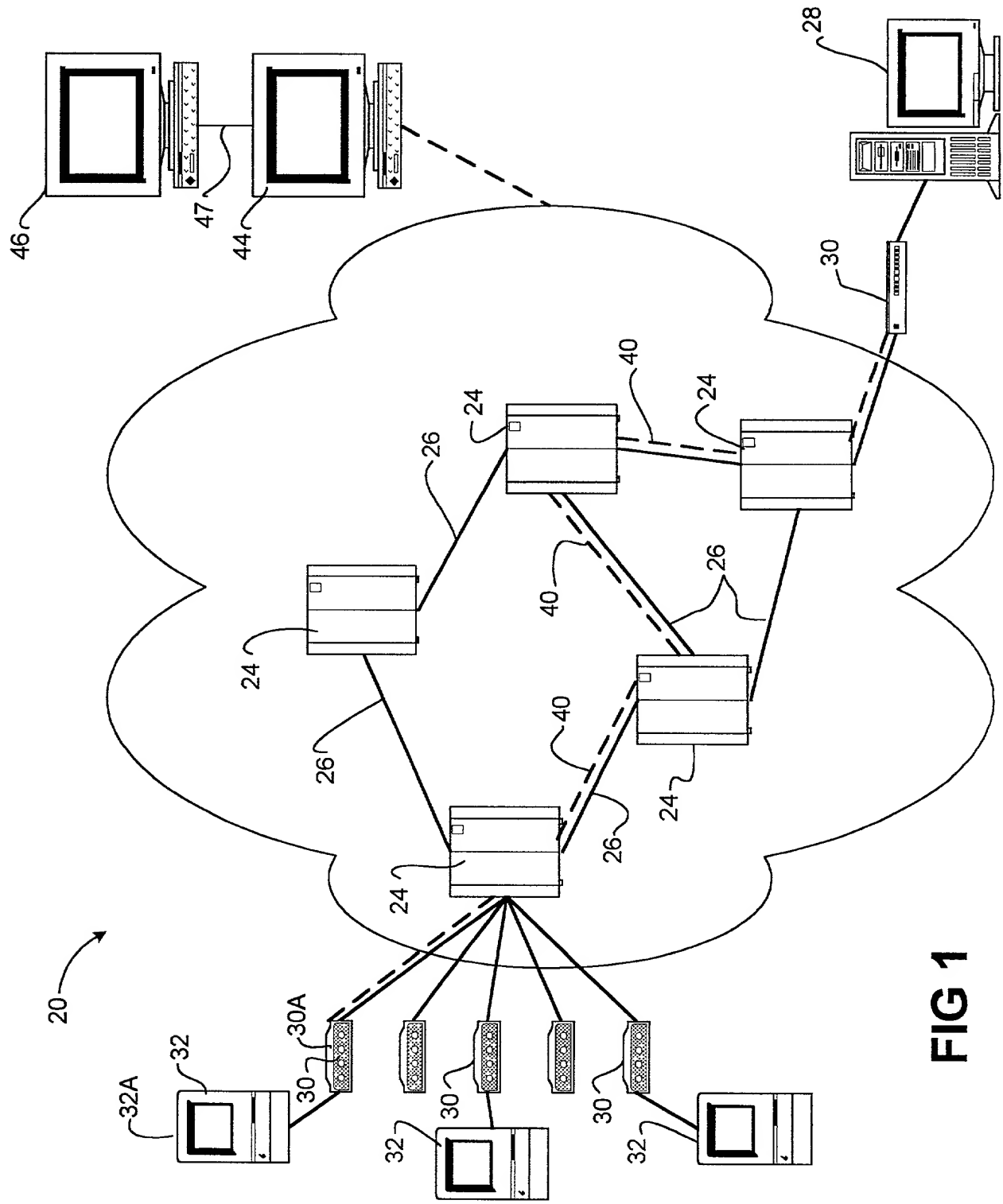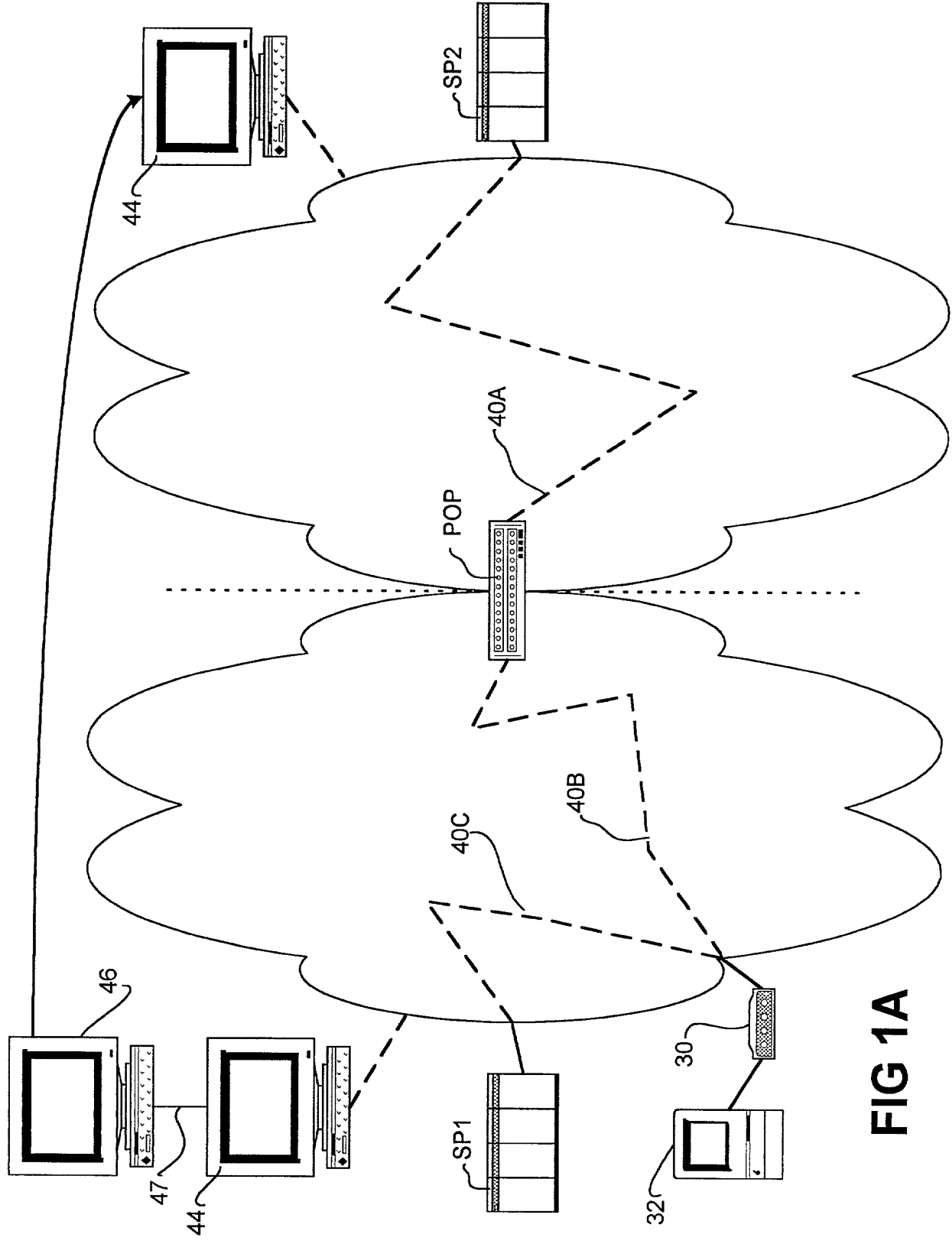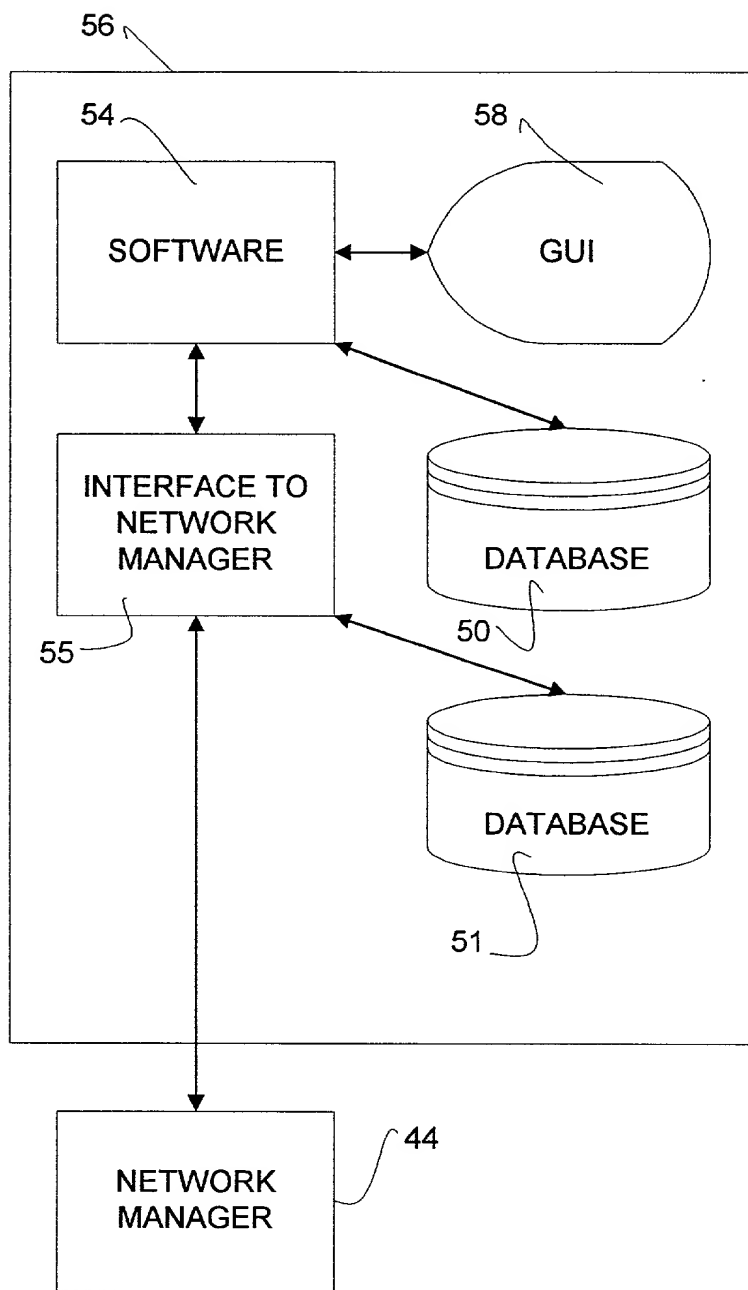
FIG 2
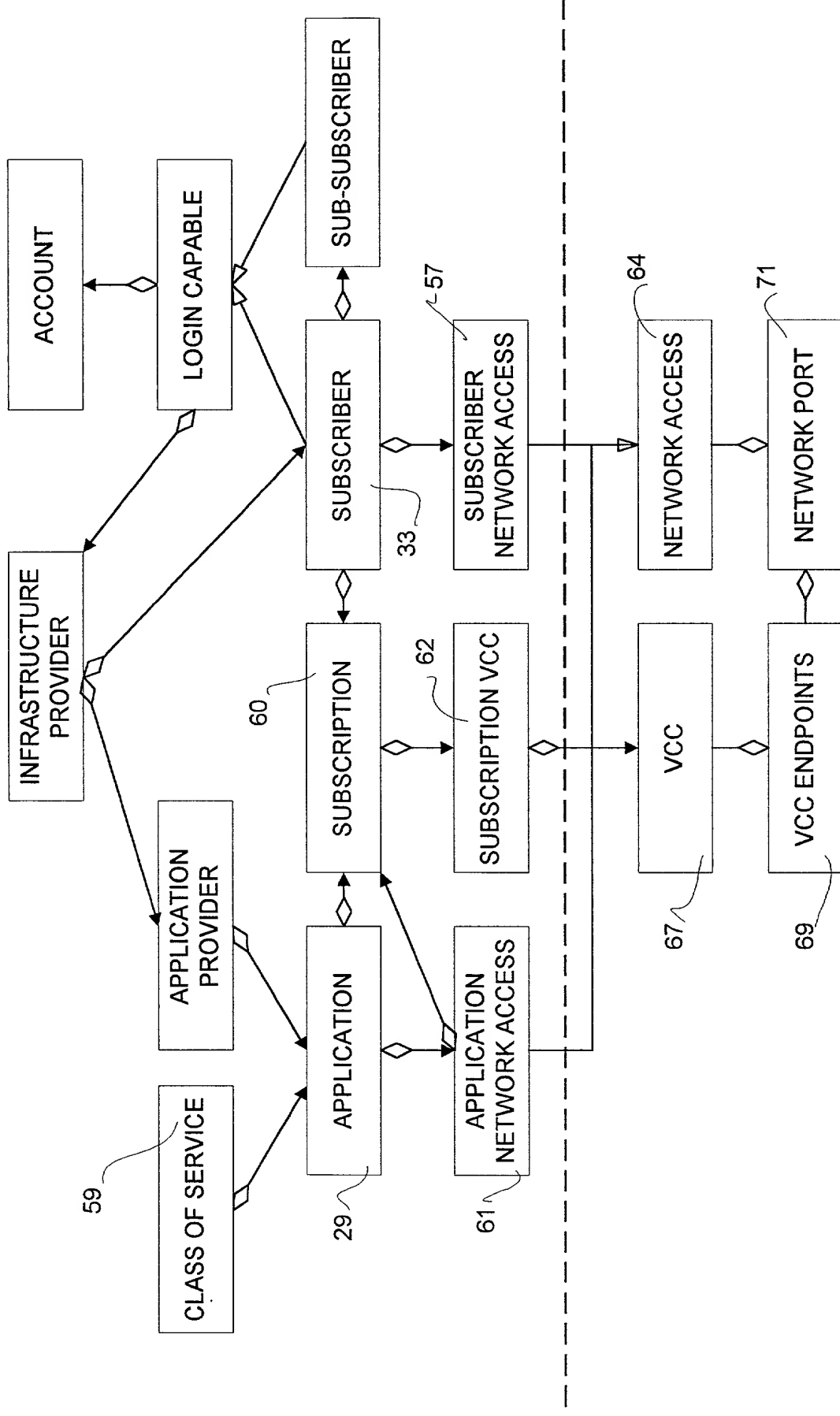
FIG 3
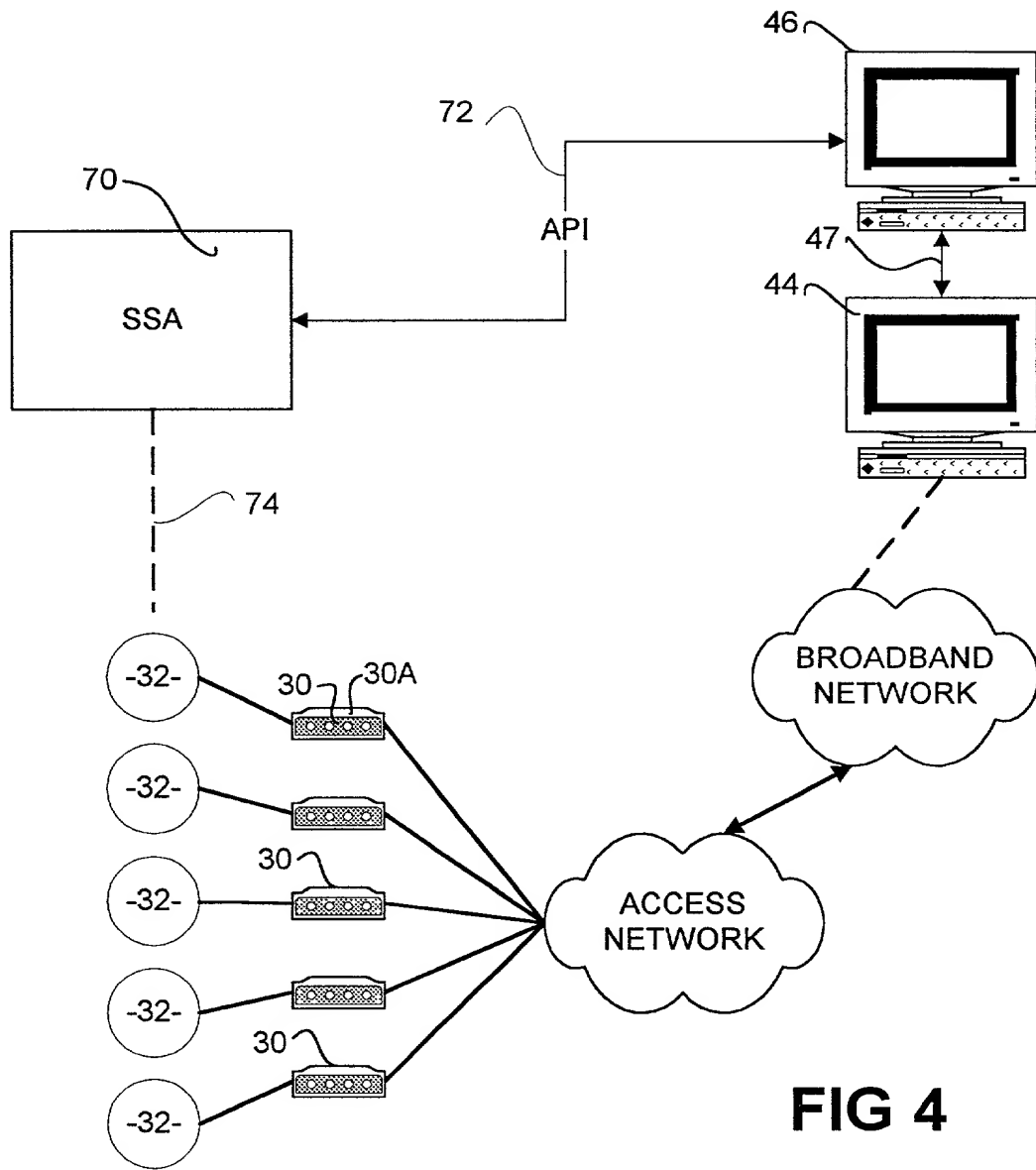
FIG 4

SUBSCRIPTION MANAGER			

SUBSCRIBED SERVICES	STATUS	AVAILABLE UNSUBSCRIBED SERVICES
ONLINE GAMES 1	ENABLED	AUDIO 1
WORK AT HOME	DISABLED	AUDIO 2
FAST INTERNET	ENABLED	MOVIE 1
STOCK QUOTES	DISABLED	MOVIE 2
		MOVIE 3
		ONLINE SHOPPING
		ONLINE GAMES 2
		ONLINE GAMES 3
		SPORTS SCORES
		TELECONFERENCES

BILLING INFORMATION	SERVICE REQUESTS	HELP

FIG 5

NAME SERVER 82

70

71

84

85

USER SOFTWARE 80

GUI 58A

TIMER 86

FIG 6

```
                 ┌──────────────┐       ⌒91
                 │   REQUEST    │           ⌒90
                 │  ADDRESS OF  │
                 │  SERVER 71   │
                 └──────┬───────┘
                        │
                        ▼
                 ┌──────────────┐       ⌒92
                 │  CONNECT TO  │◄─────────────┐
                 │   ASSIGNED   │              │
                 │  SERVER 71   │              │
                 └──────┬───────┘              │
                        │                      │
                        ▼                      │
                 ┌──────────────┐       ⌒93    │
              ┌─►│   RECEIVE    │              │
              │  │ COMMANDS AND │              │
              │  │ FORWARD FOR  │              │
              │  │PROCESSING BY │              │
              │  │   SERVER     │              │
              │  └──────┬───────┘              │
              │         │                      │
              │         ▼                      │
              │  ┌──────────────┐       ⌒94    │
              │  │   MEASURE    │              │
              │  │RESPONSE TIME │              │
              │  │ AND COMPARE  │              │
              │  │ TO THRESHOLD │              │
              │  │     TIME     │              │
              │  └──────┬───────┘              │
              │         │                      │
              │         ▼                ┌─────────────┐   ⌒95
              │       ╱────╲             │   REQUEST   │
              │      ╱      ╲    Yes      │ ADDRESS FOR │
              │  RESPONSE TIME ─────────►│  DIFFERENT  │
              │      ╲ TOO  ╱            │   SERVER    │
              │      SLOW?  ╱            └─────────────┘
              │       ╲────╱
              │         │
              │        No
              └─────────┘
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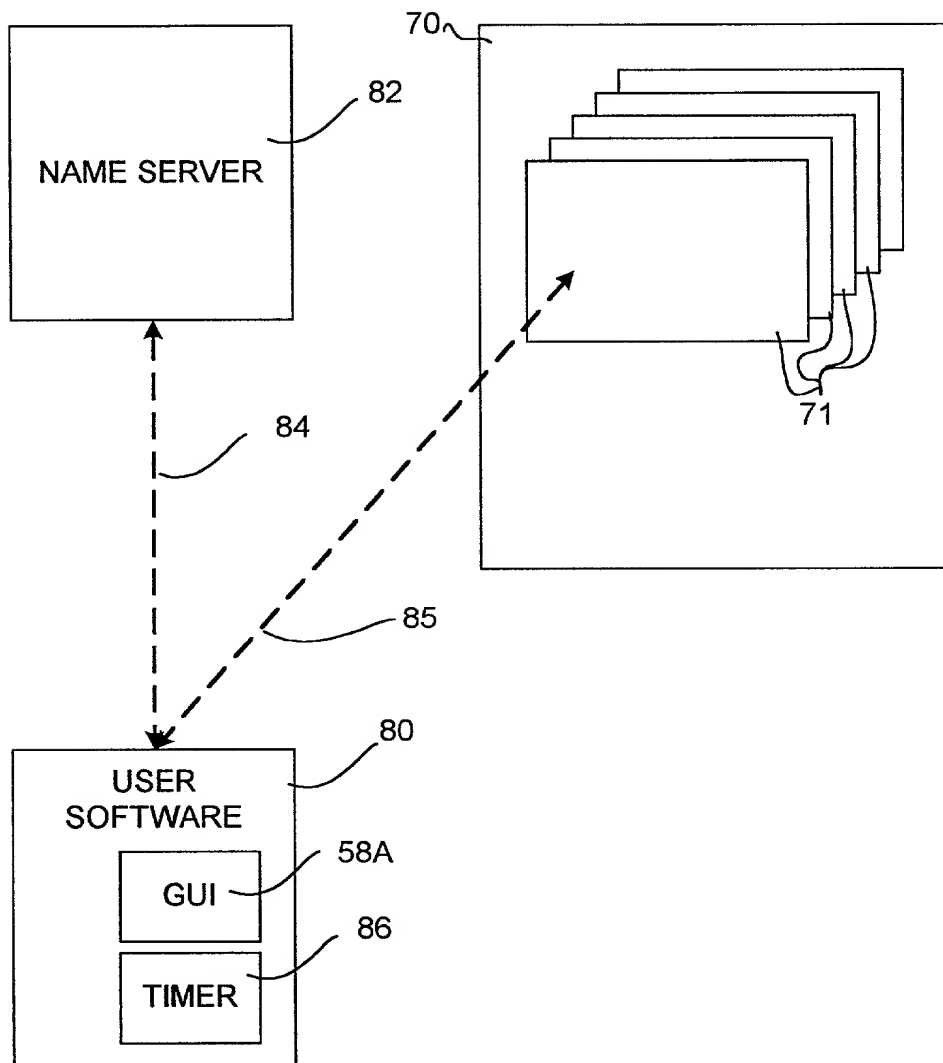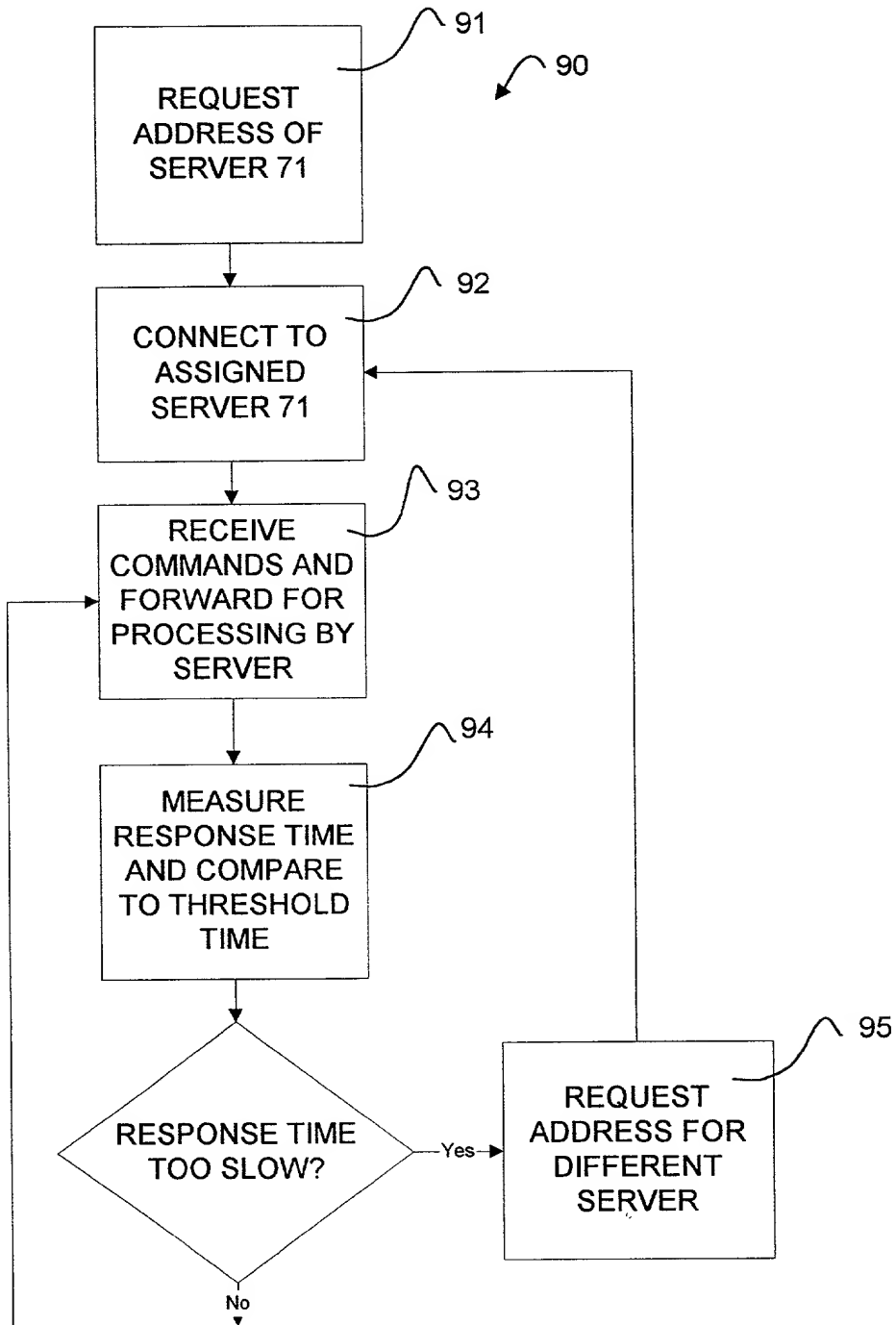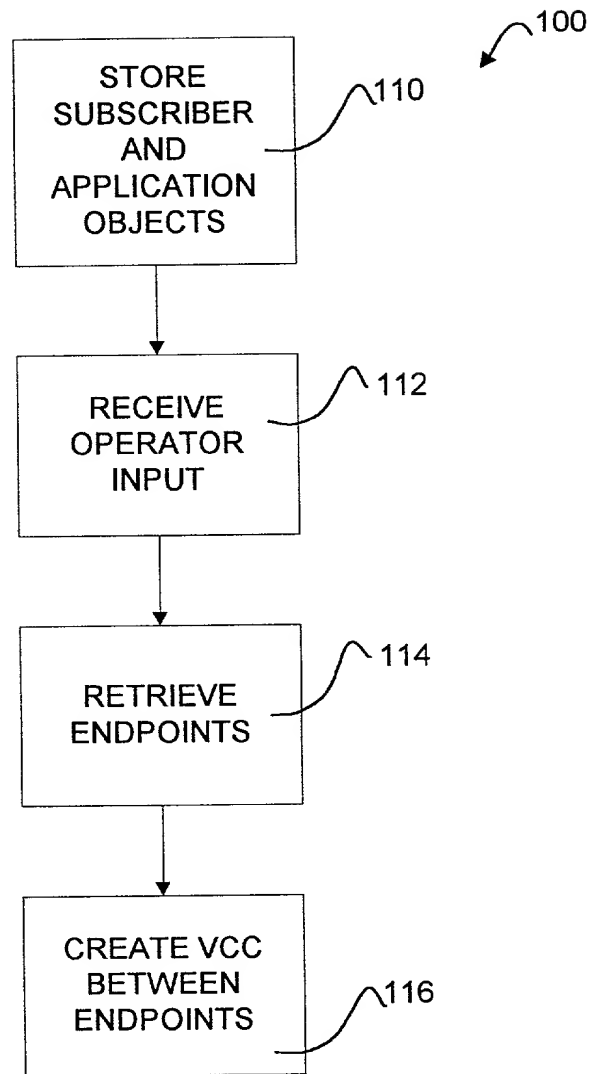
FIG 6A

FIG 7

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the invention entitled:

SUBSCRIPTION MANAGEMENT SYSTEM
FOR DATA MANAGMENT NETWORK

which is described and claimed in:

   X   the attached specification; or,

   __   the specification in application Serial No. _____, filed __
             _____; or,

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge my duty to disclose information which is material to the patentability of this invention in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby appoint the following attorney(s) and/or agent(s), with full powers of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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Blake R. Wiggs	29,505	Gavin N. Manning	36,412
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David J. McGruder	32,375		

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issuing thereon.

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